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## Spotlight on the Physiology Program

*Providing information to facilitate execution of the FWS Mission*



*Steelhead Passive Integrated Transponder (PIT) tagging at Abernathy FTC.*

Physiological information for management is obtained from controlled studies that measure the effects of a treatment (e.g. handling, elevated water temperature, high water flow, restricted hatchery feeding) on a variety of physiological responses (e.g. stress level, reproductive state, seawater preparedness) in the organism of interest. The applied physiology studies conducted at Abernathy FTC are often designed to answer a specific management question pertaining to a particular species. For example, in a recent cooperative study with Canadian researchers, Abernathy FTC physiologists studied the effects of simulated catch and release angling on stress levels in captive white sturgeon. The findings of that study may be used to manage recreational fisheries for this popular sport fish in the United States and Canada.

### Are we stressing these fish?

Whether electrofishing juvenile fish in a stream to obtain population estimates or cleaning hatchery raceways, our activities can stress fish. We try to avoid stressing fish as this can have negative effects on most biological processes, including disease resistance, growth and reproduction. We can measure the degree to which an environmental condition, human activity or other variable stresses a fish by measuring the animal's stress hormone levels. In so doing, we may take actions to reduce the stressful conditions experienced by the organisms we manage.



## ***Spotlight on the Physiology Program (cont.)***

### **How do we monitor fish in the wild without changing their behavior?**

Fish biologists often need to capture and tag fish in order to monitor their behavior and movements in the wild. However, the process of capturing the animals and implanting transmitters can be stressful and alter the behavior of a fish, thereby biasing research results. For example, Abernathy FTC physiologists recently evaluated the effects of numerous tags in hatchery-reared Pacific lamprey. By determining which tag type has the least impact on natural behavior, we can ensure that tagged lamprey used in relocation efforts behave the same as their wild counterparts.

### **Why do adult returns differ at two nearby steelhead hatcheries?**

Analysis of tagging data has revealed that survival to adulthood of steelhead released from one state hatchery is generally 1.5 to 3 times higher than that of the same stock of steelhead released from a nearby hatchery. The mechanisms for the differences in post-release performance between fish reared in the two hatcheries are unknown. Different hatchery rearing protocols (densities, pond rearing, feeding rates, etc.) and different acclimation protocols have been theorized as possible explanations for these differences. Physiologists at Abernathy FTC are analyzing gill samples collected from steelhead at both hatcheries to determine whether these differences could be related to the fishes' ability to transition from a freshwater environment to a saltwater environment which is essential for successful migration to the ocean.

### **Are we increasing early sexual maturation rates in hatchery salmon?**

High energy diets and high feed rates used in salmon hatcheries can cause early sexual maturation in male salmon. Early maturing male salmon may stay in freshwater and spawn at an early age rather than migrate to the ocean to feed. The smaller males can negatively affect freshwater ecosystems through increased predation and competition for limited resources. Consequently, studies have been conducted at Pacific Region NFHs to determine whether restricted feeding can reduce early male maturation in salmon. Physiologists at Abernathy FTC are assisting with these projects by measuring plasma levels of 11-ketotestosterone (an indicator of male sexual maturation) in hatchery salmon that are fed different amounts of feed. This project may result in alternative feeding practices which reduce premature male maturation rates at salmon hatcheries.

### **How might changing ocean conditions affect spawning success at a hatchery?**

There is little information on the effects of ocean conditions on salmon egg quality and reproductive success. To increase our understanding of this relationship, Abernathy FTC physiologists are comparing the nutrient profile of coho salmon eggs to the total number of eggs produced per female as well as to the growth and development of the eggs and resulting fry. Such information may be used by managers who regulate ocean fisheries for species that are prey items for salmon.

## **Staff**

### *Administration & Facilities*

Patty Crandell, Director  
Roger Root, Acting Deputy Director  
Steve Dyer, Administrative Officer  
Alina Nestjorkina, Administrative Assistant  
Mark Hack, IT Specialist  
Steve Money, Facility Operations Specialist  
Jeff Poole, Water Treatment Plant Operator  
Jim Lowell, Maintenance Worker

### *Conservation Genetics*

Christian Smith, Regional Geneticist  
Justin Bohling, Conservation Geneticist  
Matt Smith, Conservation Geneticist  
Brice Adams, Conservation Geneticist  
Jennifer Von Bargaen, Lab Geneticist  
Matt Piteo, Biological Science Technician  
Ben Prom, Biological Science Technician

### *Nutrition & Physiology*

Ann Gannam, Regional Nutritionist  
Richard Glenn, Microbiologist  
John Holmes, Fish Biologist  
Ron Twibell, Acting Regional Physiologist  
James Barron, Fish Biologist  
Kelli Hawke, Biological Science Technician  
Rachel Headley, SCA Intern

### *Quantitative Ecology & Technology*

Doug Peterson, Senior Scientist  
Ben Kennedy, Fish Ecologist  
Will Simpson, Fish Biologist  
Kurt Steinke, Electronics Engineer  
Katey Straley, SCA Intern



# Program Highlights

## Administration & Facilities

Roger Root from the Ventura FWO returned to Abernathy FTC on a 120-day detail. Yay!

Abernathy FTC got a huge upgrade in bandwidth. Just in time! Computer updates were taking all morning to load.

The Julia Butler Hanson YCC visited as part of the NWR's efforts to expand their experience. The crew of four and their supervisor came for a day of conservation work. They did a great job planting 15 cedars and removing thistle, blackberry, morning glory, and tansy from Abernathy

FTC. Besides removing invasive plants, the crew also weeded around willow and other plants planted to restore An amphibian pond last year. Alina coordinated the YCC's work.

Environmental engineers from Interfluve visited Abernathy FTC to conduct drone based aerial photo surveys of a recently restored creek side channel on FWS property. These photos will be used to compare current versus future side channel habitat conditions. Ben K. tagged along to gain experience since he will be piloting an Abernathy FTC drone in the near future!

Johnna Roy and Doug Threlhoff visited from the Pacific RO to discuss the data management at Abernathy FTC and how it relates to Pacific Region NFH data.

Racheal Headley, SCA intern, was presented with a framed certificate of appreciation in recognition of her hard work in the Nutrition & Physiology Program during the past year. QET welcomed new SCA intern, Katherine Strailey. She hails from CA, received her BS from the University of HI at Manoa, and has worked in fisheries with watershed steward programs in N. CA.

Abernathy FTC staff completed all of their accomplishments in FIS.

Steve D., Steve M., and Alina assisted Ankeny NWR with crowd control during the eclipse. They spent the night at the NWR before getting their assignments. Alina has also been helping CGS with its backlog. Great employees exemplifying the One Service, One Mission motto!

Our facilities staff led the charge on the annual AFTC barbeque, and with four species of fresh fish on the grill and in the fryer, and a range of salads, sides and deserts. It was the best one that many of us could remember. Staff enjoyed taking time to visit with each other and with folks from the RO who were able to join us.



Katelyn Strailey, the new SCA Intern for the QET program.



Racheal Headley, SCA Intern, received a certificate of appreciation signed by Roy Elicker.



New roof for the selective breeding building! The goal was only to replace the roof, but much of the wood they exposed during the process was rotten, so many other parts have been replaced. Photo Credit: Steven Dyer.

# Program Highlights— continued

## Conservation Genetics

Brice and Ben P. participated in the interagency Clark Fork River Aquatic Implementation Team Meeting. Brice presented results of ongoing work facilitating Bull Trout Passage in the system, and surprised all attendees with the finding that suspected Brown Trout eggs which had been removed from redds in the drainage were actually Mountain Whitefish eggs.

Two Abernathy FTC genetics projects were highlighted in the media this summer. While neither mentioned us by name, both served to get the word out about the applied nature of the genetics work we do. First, the use of genetic information to Facilitate bull trout passage above Clear Creek Dam, WA was featured in an article on OPB. The story is available at:

<http://www.opb.org/news/article/will-years-of-work-to-save-one-fish-run-be-for-naught/>

Second, the use of genetic information to reduce inbreeding in fish at Livingston Stone NFH was highlighted in a story that Hakai Magazine ran on hatcheries in California (<https://www.hakaimagazine.com/article-short/california-state-salmon/>).

Both articles indicated the importance of this work in conserving T&E species. The volume of rapid response work being conducted here is one of the factors in distinguishing our laboratory from our partner's laboratories, and it emphasizes the applied na-

ture of the genetics work we do.

An article written by Pat DeHaan (while he was at Abernathy FTC), Brice, and coauthors at Oregon Department of Fish and Wildlife (ODFW) was awarded the 2017 Stevan Phelps Award for Best Genetics Paper in an American Fisheries Society publication. The paper used data which our agencies collected over several years of Oregon chub reintroduction efforts to identify guidelines that could be used to inform future reintroductions and recovery of other species. This award signifies recognition by our peers in the broader scientific community of the high caliber of science being conducted by the USFWS. Congratulations to Pat and Brice! The article is available at: <http://afs.tandfonline.com/doi/full/10.1080/02755947.2016.1206641>

Ben Prom left Abernathy FTC in August, after working as a biotech in the genetics laboratory for a year and a



half. During his time here, Ben conducted Single Nucleotide Polymorphism (SNP) and microsatellite genotyping on a range of species, including Abernathy Creek steelhead, Nisqually River Prickly Sculpin, and Clark Fork River Bull Trout. We will miss Ben's skill in the lab and his good nature, and we wish him luck in his future endeavors.

## Publications and Reports

- Bohling, J. H., Mastro, L. L., Adams, J. R., Gese, E. M., Owen, S. F., and L. P. Waits. 2017. Panmixia and Limited Interspecific Introgression in Coyotes (*Canis latrans*) from West Virginia and Virginia, USA. *Journal of Heredity* 108:608–617.
- Adams, B., B. Prom, and J. Von Bargaen. 2017. Genetic Analysis of Native Salmonids from the Lake Pend Oreille and Clark Fork River System, Idaho and Montana. AFTC Final Report CY2016.
- DeHaan, P., J. Von Bargaen, M. Brinkmeyer, C. Smith, T. Desgroseillier, M. Cooper and G. Fraser. 2017. Genetic Evaluation of Juvenile Chinook Salmon in the Entiat River. Final Report.
- Glenn, R. and K. Hanson. 2017. Temperature monitoring of Chinook salmon gametes during transfer from Little White Salmon National Fish Hatchery to Warm Springs National Fish Hatchery. Abernathy Fish Technology Center Final Report.
- Twibell, R., Headley, R., Glenn, R. and Hanson, K. 2017. Effects of a partial reuse aquaculture system (PRAS) on proximate composition and smoltification of BY2016 steelhead (*Oncorhynchus mykiss*) reared at Hagerman National Fish Hatchery. AFTC Final Report.



# Program Highlights - continued

## Conservation Genetics (continued)

Matt S. met with biologists at Seattle City Lights to discuss a potential collaboration to evaluate population genetic structure of bull trout in the Skagit River, WA.

## Nutrition & Physiology

For the Fish Feed Quality Control Program, 13 feed samples were received from the hatcheries in July and August. The purpose of the FFQC program is to ensure that fresh feed that meets the dietary requirements of the fish is used at our National Fish Hatcheries (NFH). Two diets from Winthrop NFH were tested for additional nutrients due to the presence of cataracts in spring Chinook fed these diets. In addition, a new feed contract statement of work for Regions 1 & 8, valid for five years, was submitted to CGS to be put into the system for bids. The current contract expires in November.

Racheal (SCA Intern), Richard, and Ron assisted Columbia River FWCO office with the final sampling of up-river bright (URB) fall Chinook at Willard NFH. Samples were taken to assess the physiological status (body lipid, hormone levels, seawater preparedness) of these fish at release. The goal of the project is to determine the influence of feeding rates on precocial parr, minijack, and jack production for subyearling URB fall Chinook salmon reared and released from a NFH.

James started the third year of the Chelan PUD project. This project is being conducted to provide data concerning husbandry and rearing requirements, and rearing success of Pacific lamprey ammocoetes (*Entosphenus tridentatus*). Specifically this year we will investigate rearing conditions and methodology including water temperature, photoperiod and diet. The first lamprey study trial was completed for the third year of the Chelan PUD funded project, “Development of artificial propagation methods for production of juvenile Pacific lamprey (*Entosphenus tridentatus*) for use in research associated with Section 4.2.3 of the Rocky Reach Pacific Lamprey Management Plan”.

Ron and Racheal worked with staff from Conservation Genetics on using a more exact method for determining readiness to smolt for juvenile salmonids (gene expression related to ATPase activity). This work is important because of concerns that hatchery reared salmon smolts may not be as prepared to migrate to the ocean as wild smolts and to monitor smoltification of salmonids reared in experimental units such as partial reuse aquaculture systems.

In a coordinated effort with FTCs from Regions 2, 4, 5, and 6, a proposal, “Temperature Effects on Aquatic Organisms”, was submitted to Nathan Wilke Chief, Branch of Hatchery Operations and Applied Science for funding.

Kari Dammerman of the Columbia River Fish and Wildlife Conservation Office presented the coho egg composition study, initiated at Abernathy FTC, at the national AFS meeting in Tampa, FL. The title of the talk was “Fecundity, egg biochemical composition, and early life development of coho salmon (*Oncorhynchus kisutch*)”, K. Dammerman, R. Twibell, R. Headley and P. Crandell authors.



Sean Fitzmaurice, Will Simpson, and Steve Money working on PIT antenna array in the Umatilla River near the Hermiston Water Recycling Plant. Photo credit: Benjamin Kennedy



*A portion of the PIT array on the Umatilla River near the site of the Feed Canal diversion structure. Photo credit: William Simpson*

## **Nutrition & Physiology (continued)**

The Northwest Indian Fish Commission Fish Health contacted Ron about a sunburn issue in steelhead at one of their hatcheries. Suggestions were given concerning the analysis of their feed to determine whether the sunburn could be nutritionally related.

Kirk Groves, Fish Biologist in the Klamath Falls FWO contacted Ann about diets for Lost River suckers and is sending a novel feed ingredient for analysis.

Ann was contacted by Ennis NFH's manager, Dr.

Connie Keeler-Foster, to discuss feed contracts, feed quality and how to change the way the Mountain-Prairie Region purchases feed.

## **Quantitative Ecology & Technology (QET)**

QET staff, led by Will, built and deployed Passive Integrated Transponder (PIT) antenna arrays at two locations in the Umatilla River system to measure movement and entrainment of juvenile Pacific lamprey as they migrate to the ocean. The work supports collaborative research by Bureau of Reclamation (BOR), NOAA-Fisheries, and Confederated Tribes of Umatilla Indian Reservation to reduce entrainment of Pacific lamprey at irrigation headgates. The field crew who installed the antennas included Will, Kurt, Ben K. Steve M., Katey (SCA Intern), and Sean Fitzmaurice from Columbia River FWCO.

Will traveled to Hagerman NFH to conduct a mobile antenna survey of the facility's effluent settling basins to determine if shed PIT tags were present. The presence and abundance of shed tags would be used to determine whether steelhead reared in water-saving partial reuse aquaculture system (pRAS) tanks lose tags at higher rates than those reared in traditional flow-through hatchery raceways. The data will be used to help determine whether post-release survival estimates of steelhead reared in pRAS tanks are subject to bias from tag loss.

Doug and Kyle Hanson from Columbia River FWCO compiled and analyzed empirical and simulated environmental data for stream flow, air temperature and water temperature as part of the climate change vulnerability assessment for the Leavenworth NFH.

QET staff assisted biologists from the Western Washington FWCO with design and construction of PIT antennas to monitor movement of native fish. Roger Tabor traveled to Abernathy FTC and worked with Kurt and SCA Intern Paul Kieras to design and construct two large PIT tag antennas that were installed in Fry- ingpan Creek, Mt. Rainier National Park, to monitor movement of ESA-listed bull trout. Kurt provided additional technical support to set up PIT readers.



*A worker vacuums bald-faced hornets from a large paper nest hanging in a fish tank. This species is a bald faced hornet, not a true hornet. Workers aggressively defend their nest by repeatedly stinging invaders. The removal was at no charge. Venom will be harvested by a pharmaceutical company that uses it to make antidotes for people with life-threatening allergies. Photo Credit: Steve Money.*

# Outreach

Abernathy hosted the nPOWER Girls Project Science Camp on Tuesday. Thirty-four girls ages 8-14 participated in four workstations which were designed by Abernathy staff to illustrate how we use science to advance the mission of the FWS.

Abernathy FTC set up and manned a booth at the annual Cowlitz Co. Fair.

Ron gave a presentation on Abernathy FTC's history, mission and programs to the Longview Noon Rotary Club. Approximately 70 Rotarians were wowed to learn that there was a research center so near.

The Tualatin NWR Youth Conservation Corps took a tour of Abernathy FTC. They spent several hours learning about how the FTC contributes to the conservation mission of the FWS by providing technical assistance and research to Fisheries and Aquatic Conservation.

## ***Meetings, Conferences and Trainings***

- Patty, Ann and Christian attended the FTC meeting at NCTC and provided regional and station updates. Geneticists, physiologists, and nutritionists held breakout groups at NCTC to identify and discuss challenges and to develop strategies for sharing technology across regions. QET participated in a call outside of the FTC meeting. A framework was developed to establish a Nutrition & Physiology Community of Practice. David Hoskins attended the first day and several "systemwide opportunities" were forwarded to him last week. The only project that would include Abernathy FTC concerned determining thermal tolerances for T&E aquatic species. All Directors supported the following:
  - \* Possible name change for all FTCs. XXX Aquatic Resource Center was suggested for the ARDs to consider.
  - \* The return of FTC evaluations. All Directors supported a "useful" evaluation process.
  - \* A recommendation that FTCs not be involved with a National IACUC. It was agreed that a National IACUC would be expensive and unnecessary for FTCs.
  - \* Staff sharing and transfer of information and skills among FTCs is a priority.
  - \* Next FTC meeting is tentatively scheduled for October in Anchorage, AK or San Marcos, TX.
- Ben K. and Patty met with Mara Zimmerman (WDFW) to discuss the future of the Abernathy Creek steelhead reproductive success project funded by the BPA. The project is now winding down, and is will be phased out over the next two years. Washington Department of Fish and Wildlife (WDFW) has participated directly in this project by running a rotary screw trap at the mouth of Abernathy Creek that capture wild- and hatchery-origin steelhead smolts. WDFW has indirectly benefited from Abernathy FTC's operation of PIT interrogation stations (funded by BPA) because they provided detection events for PIT-tagged fish from other studies, such as an investigation of early seaward migration by juvenile Coho salmon.
- Ron conducted the safety training on Hazard Communication.
- Ben K. participated in a Pacific Lamprey Conservation Team meeting with other FWS and partner personnel to review and update lamprey conservation plans, projects, and funding sources. Additionally, the team discussed the preparation progress of the upcoming Pacific Lamprey Summit in December.
- Ann attended a luncheon with the ARDs for a "meet and greet" at their annual meeting. She was given the opportunity to share what types of research done at the Abernathy FTC.
- Ann participated in a conference call with the Fish and Aquatic Conservation Training and Employees Development Workgroup. Discussions included setting up Capstone projects for the next Fisheries Acade-



my, how to notify employees and supervisors about classes offered outside of FWS and distributing information out about details.

- Matt S. met with biologists at Seattle City Lights to discuss a potential collaboration to evaluate population genetic structure of bull trout in the Skagit River, WA.
- Patty and Christian participated in a meeting with Gorge Complex, Columbia River FWCO and Regional Office staff to discuss recent requests from NOAA Fisheries regarding the Little White Salmon NFH Bi-OP.

## Ongoing Projects

**Water velocity effects on salmon as reared in recirculating systems.** *Management Need:* Determine the effects of water velocity on composition, growth, condition, and performance of juvenile PNW salmon as applied to recirculating systems in support of hatcheries in the Pacific Region considering the use of recirculating systems. *Partners:* Pacific Region National Fish Hatcheries, Fishery Resources Program via Fisheries Operations and Need System (FONS).

**Diet development for Lost River and short nose suckers in the Klamath River Basin.** *Management Need:* Determine dietary needs of listed populations to assist in recovery. *Partners:* Klamath Tribes, Klamath Falls FWO, California/Nevada FHC.

**Development of diets and rearing techniques for the culture of Pacific lamprey, *Entosphenus tridentatus*.** *Management Need:* Assist Tribal partners in developing methods for the artificial propagation of Pacific lamprey, a species of concern. *Partners:* Yakama Nation; NOAA Fisheries and Chelan PUD.

**Pacific Region's Fish Feed Quality Control (FFQC) Program.** *Management Need:* The FFQC Program, the only one of its kind in the FWS, provides quarterly monitoring of the quality of the commercially produced fish feeds used at Pacific and Pacific Southwest Regions' NFHs. Information is compiled on an annual basis and used in the development of the Pacific Region fish feed contract. *Partners:* Pacific and Pacific Southwest Region's NFHs, Oregon, Washington, Idaho, and Tribal fish hatcheries.

**Effects of dietary lipid source and ultraviolet radiation on sunburn and steatitis in Steelhead, *Oncorhynchus mykiss*.** *Management Need:* Provide information regarding the potential relationship between fish nutrition and sunburn in steelhead. *Partners:* Pacific Region National Fish Hatcheries.

**Natural reproductive success and demographic effects of hatchery-origin steelhead in Abernathy Creek, WA.** *Management Need:* Provide information to help managers minimize differences between NOR and HOR fish. *Partners:* Bonneville Power Administration; Washington Department of Fish and Wildlife.

**Aquatic Organism Passage (AOP) at remediated stream road crossings.** *Management Need:* Assess the efficacy of genetic, direct capture, and remote sensing methods to verify fish passage through remediated culverts. *Partners:* US Forest Service, Trout Unlimited.

**Climate change vulnerability assessments of Pacific Region National Fish Hatcheries.** *Management Need:* An understanding of the anticipated habitat changes under different climate change scenarios provides managers with information to proactively respond to these conditions and their impact on NFHs. *Partners:* Pacific Region NFHs; Mid-Columbia River FRO; Fishery Resources Program via FONS.

**Antenna design for the Biomark IS1001 PIT tag reader.** *Management Need:* Provide expert level engineering and technical assistance to partners monitoring species of interest using new technologies while reducing biologist time spent in design and troubleshooting. *Partners:* NOAA Fisheries, USFWS Green Bay.

**Entrainment and bypass of ESA-listed salmon at irrigation diversions on the Umatilla River.** *Management need:* Determine what environmental factors influence the magnitude of fish entrainment into irrigation canals and if captured fish are successfully screened and returned to the Umatilla River using PIT tag technology. *Partner:* Bureau of Reclamation.

**Stress response of juvenile steelhead salmon to electrofishing and tagging under different thermal regimes.** *Management need:* To understand how fish respond to capture and handling under conditions experienced in late summer. *Partners:* USFWS Directorate Fellows Program.

**Evaluation of the spatial and temporal distribution of juvenile Chinook salmon in the Entiat River.** *Management Need:* Use genetic data to improve our understanding of the distribution of spring and summer run Chinook salmon juveniles and thus improve our ability to prioritize restoration projects targeting spring Chinook salmon recovery. *Partners:* USFWS Mid-Columbia FWCO.



## Ongoing Projects—continued

**Design and installation of a PIT tag array to monitor outmigration of juvenile Pacific lamprey in the Umatilla River.** *Management need:* Determine entrainment rates of juvenile lamprey as they move downstream through the Umatilla River. *Partners:* NOAA-Fisheries, U.S. Bureau of Reclamation.

**Rapid response genetic analysis of threatened bull trout collected below dams in the Clark Fork River, MT.** *Management Need:* Provide data to inform upstream fish passage decisions for listed bull trout. *Partners:* Avista Corporation; Confederated Salish Kootenai Tribes; Idaho Fish and Game; Kalispel Tribe of Indians; Montana Fish Wildlife & Parks; Montana Ecological Services Field Office; Pend Oreille Public Utility District; Pennsylvania Power & Light, MT.

**Genetic identification of endangered winter-run Chinook salmon in the Sacramento River, CA.** *Management Need:* Rapid response broodstock identification for spawning of listed species. *Partners:* Livingston Stone NFH; Red Bluff FWO; NOAA Fisheries.

**Genetic analysis of bull trout in the Lewis River system.** *Management Need:* Facilitate passage of bull trout past hydroelectric facilities. *Partners:* Washington FWO, Columbia River FPO, PacifiCorp, U.S. Forest Service, Washington Department of Fish and Wildlife.

**Relative reproductive success of hatchery and wild steelhead in the Deschutes River basin.** *Management Need:* Develop genetic markers to monitor genetic diversity of listed populations. *Partners:* Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, Columbia River Intertribal Fish Commission.

**Genetic needs assessment for endangered Lost River and short nose suckers of the Klamath River Basin, OR.** *Management Need:* Develop genetic markers to monitor genetic diversity of listed populations. *Partners:* Klamath Falls FWO, U.S. Geological Survey.

**Genetic profiles of broodstock at Pacific Region National Fish Hatcheries.** *Management Need:* Determine impacts of hatchery origin fish (HOR) on naturally occurring fish (NOR) and monitor the effects of aquaculture practices on HOR populations. *Partners:* Pacific Region NFHs, Fishery Resources Program via FONS.

**Genetic run assignment of juvenile Chinook salmon from the American River.** *Management Need:* Assess accuracy of length-at-date method for distinguishing Spring run (ESA listed) from Fall run (unlisted) Chinook salmon smolts. *Partner:* Pacific Southwest Regional Office.

**Bull trout SNP marker discovery using RAD-seq.** *Management need:* Identify a standardized panel of SNP genetic markers that can be applied to population genetics studies across the species' range. *Partners:* Washington Department of Fish and Wildlife, Columbia River Inter-Tribal Fish Commission.

**Evaluating population structure and effective population size of redband trout in the Deschutes River, OR.** *Management need:* Genetic data will help identify management units for redband trout in the Deschutes River basin. *Partners:* Oregon Department of Fish and Wildlife.

**Genetic assessment of bull trout in the Upper Willamette River, OR.** *Management need:* Provides genetic information relevant to assessing the conservation status of the species and fish passage. *Partners:* Oregon Department of Fish and Wildlife.

**Use of Genetic Analysis to Determine Origins of Prickly Sculpin Populations in Nisqually River Basin.** *Management Need:* Evaluate the use of genetic tools to identify origin of an introduced population. *Partner:* Western Washington FWCO.

**Population structure of coastal cutthroat trout inhabiting urban watersheds in Portland, OR.** *Management Need:* Compare the characteristics of urban populations with their non-urban counterparts. *Partner:* Columbia River FWCO.

**Genetic profile of Hood Canal coho salmon populations using RAD sequencing.** *Management need:* Assess differentiation between wild coho salmon populations and the genetic impact of hatchery stocks. *Partners:* Northwest Watershed Institute, Quilcene National Fish Hatchery, Washington Department of Fish and Wildlife.

**Population genetic structure of Alvord Chub and relation to Borax Chub.** *Management need:* population structure information needed to inform listing decisions and recovery planning. *Partners:* USBLM, NDOW, ODFW, OSU.

**Rapid Response Genetic Analysis of Bull Trout Collected at Clear Creek Dam, WA.** *Management need:* population of origin information needed to facilitate fish passage. *Partners:* WDFW, Mid Columbia FWCO.

**Population structure and genetic stock identification of Icicle Creek Bull Trout.** *Management need:* we require information on the origins of Bull Trout impacted by the operation of Leavenworth NFH. *Partner:* Mid Columbia FWCO.

**Effects of the Hagerman National Fish Hatchery water reuse system on steelhead physiology.** *Management Need:* Evaluate the physiological status (body composition, seawater readiness) of steelhead reared in a partial reuse aquaculture system (PRAS) at a National Fish Hatchery. *Partners:* Idaho Department of Fish and Game, Idaho Fish and Wildlife Office, Pacific Region National Fish Hatcheries.

## Ongoing Projects—continued

**Effects of ocean conditions on coho salmon egg quality at two National Fish Hatcheries.** *Management Need:* Examine the relationship between salmon egg biochemical composition and reproductive success and determine whether ocean conditions influence egg composition. *Partners:* Pacific Region National Fish Hatcheries.

**Investigate differences in adult returns of steelhead reared in two hatcheries.** *Management Need:* Determine whether physiological status plays a role in different adult return rates at two Lower Snake River Compensation Plan Hatcheries. *Partners:* Idaho Fish and Wildlife Office, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife.

**Influence of feed ration on physiology of fall Chinook salmon.** *Management Need:* Determine whether feeding rate affects precocial male maturation rates, seawater adaptation and adult returns of fall Chinook salmon reared at Willard National Fish Hatchery. *Partners:* Columbia River Fish and Wildlife Conservation Office, Pacific Region National Fish Hatcheries.

**Evaluating PIT tag loss in partial reuse aquaculture systems (PRAS) at Hagerman NFH.** *Management need:* Determine if steelhead reared in RAS tanks shed their PIT tags at a higher rate than those reared in traditional raceways so that survival estimates are not biased by unrecorded tag loss. *Partners:* Hagerman NFH, Lower Snake River Compensation Plan, Idaho FWCO

**Common carp biomass threshold experiment in Malheur Lake.** *Management need:* Determine the common carp biomass below which aquatic plants can grow; this biomass would be the target biomass for suppression of carp in Malheur Lake. *Partners:* Malheur National Wildlife Refuge, Harney County Watershed Council, Oregon Watershed Enhancement Board

**Evaluation of a poly-culture method for larval Pacific lamprey (*Entosphenus tridentatus*) using the effluent from PNW salmon hatcheries.** *Management need:* Contribute to the recovery of the Pacific lamprey in the Pacific Northwest. The innovative rearing method developed could be implemented at any existing salmonid hatchery in the region, without using any additional water resources. Effluent nutrients could be sequestered by lamprey at these facilities. *Partners:* Fishery Resources Program via FONS.

